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ABSTRACT

This paper provides a framework for estimating the economic benefits of early child development (ECD) programs and applies the framework to preliminary data from the Bolivian ECD program (known as the PIDI Project). The evaluation quantifies the benefits of increased lifetime productivity as a result of ECD enrollment. The evaluation also takes into account benefits of ECD programs that are not education related, such as direct benefits to the child (e.g., meals provided) and indirect benefits to society (e.g., greater community participation). The Bolivian PIDI program evaluated consists of nonformal home-based day-care centers where children receive nutrition, health, and cognitive development services. Each center serves 15 children, ranging from 6 months to 6 years of age, from impoverished households. Centers are staffed with 1 mother/caretaker assisted by 1 or 2 helpers, depending on the number of children under age 2. Recurrent costs could amount to between \$50 million and \$100 million annually, nearly a third of the government budget for education. Based on those benefits that are quantifiable, the evaluation of the Bolivian PIDI program indicates that those ECD programs that are well targeted and have a major impact on school enrollment and achievement are excellent economic investments. (HTH)

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THE BENEFITS OF EARLY CHILD DEVELOPMENT PROGRAMS An Economic Analysis

Jacques van der Gaag and Jee-Peng Tan

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The Benefits of Early Child Development Programs: An Economic Analysis

**Jacques van der Gaag
Jee-Peng Tan**

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Abstract

This paper provides a framework for estimating the economic benefits of early child development (ECD) programs and applies it to preliminary data from the PIDI project in Bolivia. "Economic benefits" refers first to the monetary value of the benefits in health, nutritional status, and cognitive and social development that accrue to the children who enroll in ECD programs. To these benefits we need to add benefits to the mother and other family members, to the neighborhood in which the children centers operate, and to society as a whole.

A major objective of ECD programs is to prepare young children for enrollment in primary school. Many of the benefits of ECD therefore are realized through improved enrollment and schooling achievements of ECD graduates. We take advantage of this in our evaluation. Borrowing from the literature on the economics of education, we base part of our analysis on the assumption that one of the objectives of ECD programs is to increase children's chances to become productive citizens. Productivity in this regard is defined broadly to include productivity in the marketplace as well as home production. The latter manifests itself in the relationship between, for instance, higher mother's education and children's health and nutrition status.

We quantify the benefits of increased lifetime productivity as a result of ECD enrollment. We also discuss additional benefits from education, but quantification is difficult.

Not all benefits of ECD programs are education-related. There are direct benefits to the child (e.g., meals provided at the ECD centers) and indirect benefits to society (e.g., greater community participation or lower future fertility rates). We try to catalog all benefits but, again, are not always able to place a dollar value on them.

Based on the benefits we can quantify, our preliminary results for Bolivia show that ECD programs that are (1) well targeted and (2) have a major impact on school enrollment and achievement are excellent economic investments. We also argue that if one adheres to some modest notion of social justice, ECD programs should be subsidized (or provided free of charge) for children who are born and grow up in the most deprived segments of society.

1. Introduction

In recent years, an avalanche of literature has shown the importance of good nutrition, good health, a stimulating environment, and loving care in the early years of life for the physical, mental, and social development of a child. From better school performance to lower criminal behavior, the right combination of health care, adequate food, a prolearning environment and good parenting instills qualities, however defined, that result in children and adults who are more productive, more socially adapted, and, in a general sense, "better" than those who have missed one of these factors.

The links between good nutrition and brain development, even in utero, are well known (Martorell 1996). Del Rosso and Marek (1995) document the importance of good health and nutrition for cognitive development. De-worming has had significant effects on school performance (Bundy 1997). School feeding programs have not only increased enrollment, but also achievement (Pollitt and others 1993). Preschool programs have erased the disadvantages that young children experience when they grow up in marginalized neighborhoods characterized by poverty, hunger and malnutrition, broken families, and crime (Schweinhart, Barnes, and Weikart 1993; Haveman and Wolfe 1995).

Young (1996) provides a useful summary of programs aimed at children in the early years of life that consist of a combination of nutrition, health care, and cognitive development components. These programs are collectively referred to as Early Child Development (ECD) programs. Myers (1995) provides one of the first comprehensive assessments of such programs for the developing world. Young (1997) gives a state-of-the-art review of the benefits that result from these interventions. Even the popular press (e.g., Newsweek 1995, 1997); Time 1996) has recently highlighted the importance of ECD.

It is not surprising that there is general consensus that ECD programs are particularly beneficial for disadvantaged children. Most of the components that contribute to the proper development of a child are usually present in relatively well-off households. It is also well known that, generally speaking, ECD programs are expensive. Though cost estimates vary widely (Wilson 1995), the annual cost per child can easily exceed the cost for one year of primary education. The need to target costly interventions at resource-poor areas or poor households underscores the importance of providing policymakers with information that will allow them to judge which interventions are most beneficial and still affordable. After all, in a financially constrained environment, ECD interventions compete for resources with other programs and projects such as primary education, irrigation works, or feeder roads.

In this paper we show how benefit-cost analysis can assist in providing that information, help select the "best" ECD program for the situation at hand from the myriad of program options available, and compare the economic benefits of ECD interventions with those from more standard investments. The key word is "investment." First, we argue that ECD programs are investments aimed at improving the future productivity of the child, just as education is thought to do. This allows us to estimate the (net present) dollar value of the benefits of ECD programs, to the extent that these

benefits are reflected in higher productivity levels of the ECD graduates. Subsequently, we bring in additional benefits of ECD. Though it is important to be aware of such benefits, it will not always be possible to place a monetary value on them (for instance, how does one estimate the monetary value of "improved self-esteem of the mother"?).

In the next section we give a couple of examples of benefit-cost analysis of programs that address the needs of very young children. This shows the practical use of such analysis in real-life situations, rather than in a laboratory setting. It also shows that, although the theory of benefit-cost analysis is well established, application involves many judgment calls that depend on the scope of the analysis as well as on the particular conditions under which the programs are being implemented. The examples are used to motivate the approach taken in this paper. This approach is a direct application of the literature on economics of education, particularly regarding "the rates of return to education." This literature is introduced in section 3. In that section we also list ECD benefits that are not education-related. In section 4 we apply our framework to the PIDI¹ program in Bolivia.

In section 5 we answer the question, Who should pay? As we see, a large part of the benefits of ECD programs goes directly to the child in the form of increased future earnings. On first sight, that would suggest that these children themselves (or, rather their parents) should pay for these interventions. However, ECD programs have externalities (benefits that accrue to society as a whole) which would argue for government financing or at least subsidizing. We add to this an argument in favor of government financing of ECD programs for poor disadvantaged children: any society that adheres to a minimum notion of social justice (see, for instance, Rawls 1971) should take measures to prevent children from being "doomed for life" just because they are born in poverty. Providing ECD programs is a powerful way to break the intergenerational cycle of poverty.

Section 6 concludes.

¹ PIDI is the Spanish acronym for Integrated Child Development Project.

2. Benefit-Cost Analysis of ECD Programs

The program for Women, Infants, and Children (WIC) which serves 6.5 million disadvantaged children and their mothers in the United States provides a good example of how a limited benefit-cost analysis can have a significant impact on policymaking.

The program's main objective is to improve the health and nutritional status of children. It provides supplemental food, nutrition and health services, as well as breastfeeding counseling, to nutritionally at-risk, low-income, pregnant and postpartum women and their infants and children up to five years of age. The WIC program has been evaluated extensively. It has been shown to decrease the incidence of very low birthweight by 44 percent and to reduce the incidence of late fetal deaths by up to one-third (U.S. General Accounting Office 1992; Rush and others 1988). Clearly, in a technical (health-improving) sense, WIC has been effective.

The evaluations also show that WIC has been cost effective in the sense that "for every dollar spent...the associated savings in Medicaid costs...ranged from \$1.77 to \$3.13" (U.S. Department of Agriculture 1990. p xii).² This WIC evaluation does not constitute a complete benefit-cost evaluation of the program. Benefits are only measured as reductions in the costs of another program (Medicaid). Additional benefits such as the effect of higher birthweight on future school performance are not taken into account. Still, this evaluation has had important policy implications. By showing that the WIC program could significantly reduce the costs of Medicaid, the administrators received strong and sustained political support for the program.

Another important aspect of this evaluation is that it depends completely on the existence of another program. In other words, the evaluation is very situation specific. This is generally the case for benefit-cost analysis. Consequently, most studies are unique. The results do not carry over easily to other countries (or regions or target groups).

The evaluation of the High/Scope Perry Pre-school program provides another example of benefit-cost analysis of ECD-type interventions. The study followed 123 children who were divided randomly into a program group and a control group. Information was collected annually from ages 3 to 11, at ages 14-15, at age 19, and at age 27. It included IQ scores, school performance, employment and earnings, home ownership, criminal behavior, dependency on welfare programs, and other aspects of well-being and social behavior.

Among many other results, the findings of the study (Schweinhart, Barnes, and Weikart 1993) include the following for the program group as compared to the control group: higher scores on literacy tests at age 19, higher monthly earnings at age 27, higher percentage of home ownership, higher level of schooling completed, lower percentage receiving social services, fewer arrests, and fewer out-of-wedlock births.

² These savings are for the prenatal component of the program only.

Based on these results, Schweinhart, Barnes, and Weikart calculate that "over the lifetime of the participants, the pre-school program returns to the public an estimated \$7.16 for every dollar invested" (p. xviii). How did they come up with this number?

Estimating the cost (investment) of the program is relatively straightforward. Calculating the monetary value of the benefits, however, is much more complicated and involves many judgment calls that depend on the objective and scope of the study and the specific circumstances under which the program was implemented. The authors made an effort to estimate the monetary value of the program benefits, as shown in table 1.

Table 1. Valuing the Benefits from the High/Scope Perry Pre-school Program

1. Childcare Benefits

In addition to preschool education, the program provides direct benefits in the form of childcare to the enrolled children. The monetary value of these childcare services (which are benefits that accrue to the parents) is estimated as equal to the equivalent costs of professional childcare services at the time the children were enrolled in the program.

2. Employment-Related Compensation

Program benefits were measured as the difference in earnings and fringe benefits between the program group and the control group.

3. Adult Secondary Education

Preschool participants had a lower rate of enrollment in remedial adult high school classes than nonparticipants. The value of this benefit was set equal to the costs of these remedial adult education courses.

4. Education

The education benefits of the program were estimated as increased efficiency of the education process due to higher achievements of the program group (measured as an increase in educational output—increased graduation—or as a reduction in the cost of schooling—reduced dropout). Included in these estimates are the costs of special school programs, such as classes for compensatory education, which were lower for preschool graduates.

5. Public Welfare Assistance

Preschool participants were, as adults, less dependent on the social welfare system. The associated cost savings were added to the monetary benefits of the program.

6. Delinquency and Crime

The study showed that preschool participants had lower criminal behavior. The monetary value of this benefit was calculated as the sum of the reduction in costs to victims, costs of the criminal justice system, and costs of private security measures.

Source: Adapted from Schweinhart, Barnes, and Weikart 1993.

In conducting the analysis, the authors had the benefit of longitudinal data spanning almost three decades after the preschool intervention. Many of the benefits

listed for the High/Scope Perry Pre-school program (e.g., reduced welfare dependency, reduced crime) appeared two or three decades after the intervention. That does not make them irrelevant. To the contrary, they are major contributors to the overall value of the program. But, as a practical matter, the analysis has to be done *ex ante* and certainly well before the first beneficiaries of the ECD program are at the end of their lives. Moreover, even in the best-case scenario of the current example, the authors had to restrict their analysis to those benefits that were actually measured in the various rounds of surveys.

This example again points to the fact that benefit-cost analyses are country specific. As in the WIC example, the monetary value of the benefits of this preschool program depends heavily on the presence of other programs and policies that can be considered substitutes for ECD programs (e.g., providing remedial education service or medical care for underweight babies). If these programs were abolished, the benefits of preschool education (in these examples) would appear to be diminished.

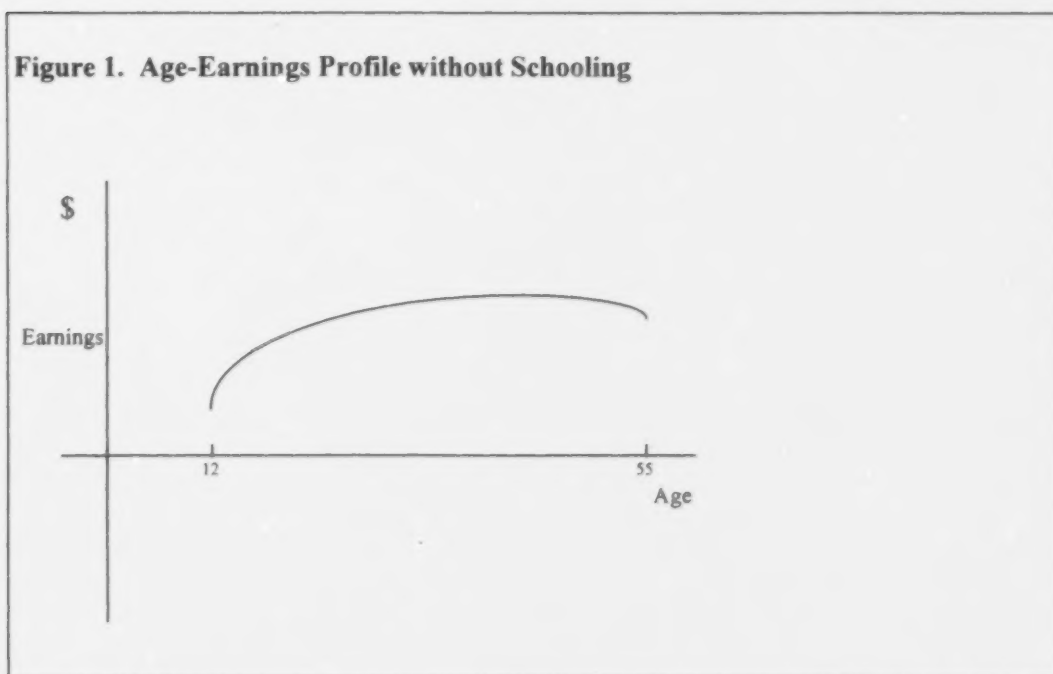
For most benefit-cost analyses it will be necessary to decide, first, which "good outcomes" of the program should be included in the evaluation and, second, how to "monetize" these benefits. This element of judgment cannot be avoided, nor is it possible to arrive at a once-and-for-all benefit-cost ratio. The specific circumstances of the program need to be taken into account every time.

In the next section we argue that one way to "sort" the quantifiable benefits (even in the absence of longitudinal data) as well as benefits that require more qualitative assessments is to borrow from the literature on the economics of education. The starting point is to adopt the position that education is an investment in human capital. This investment results in higher productivity of the educated person, which is reflected in higher earnings. The present value of these higher earnings constitutes the monetary value of the education benefits. In the next section we take a closer look at this approach and see how it can be adopted to estimate the benefits of ECD programs.

3. Benefits from Early Child Development Programs

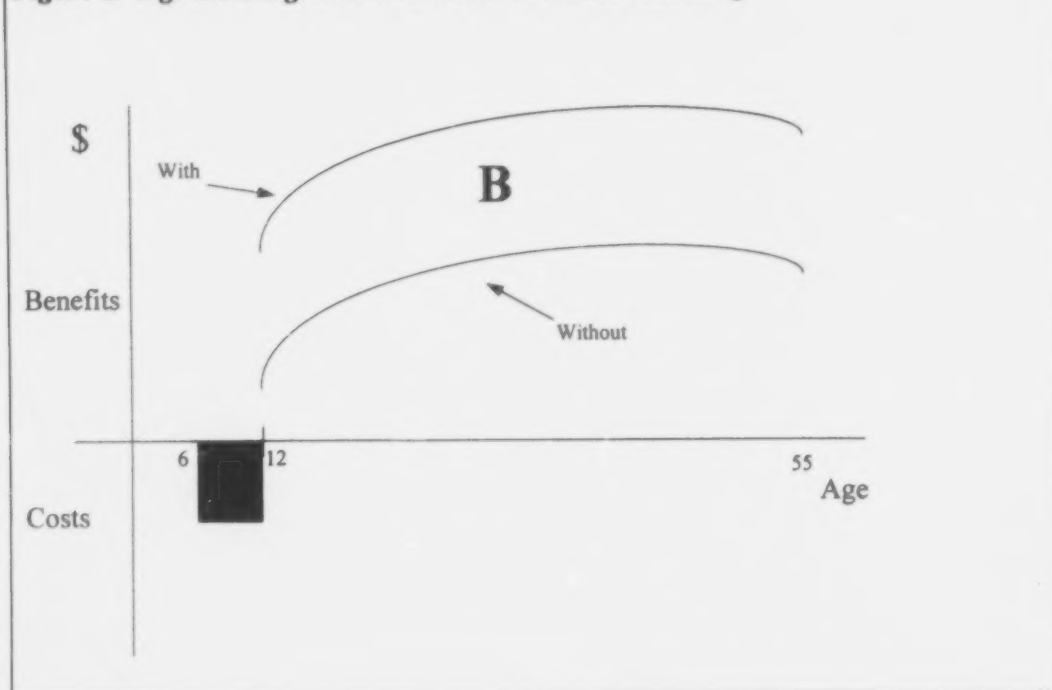
3.1 The Economic Benefits of Education

A central feature of the literature on the economic returns to education is the so-called "age-earnings profile." Imagine a young child who grows up healthy, well-nourished, and without any damage to her cognitive and emotional development. She stays at home until the age of, say, 12 and then starts helping her parents in the field. Or perhaps she helps a family member in the household or does simple work in a local store. She did not go to school and cannot read, write, or do basic calculations. Her productivity in the first year is low, but she learns from experience: during her first years of work, her productivity (and thus her income) increases, but after a while she reaches her maximum level of productivity. At the age of, say, 55 she retires. This pattern of productivity over her lifetime (her "age-earnings profile") is sketched in figure 1.



Now let's look at the same girl, and let's put her in school at age 6. This comes at a cost, illustrated in figure 2 by the gray area. When she goes to work at age 12, she can read the instructions on the box of fertilizer or pesticides, or she can work the cash register at the store. Her productivity is higher than in the case without schooling, *for the rest of her life*. By comparing the increase in lifetime productivity (area B in figure 2) to the cost of education (area C, the "investment") we can calculate the economic returns to education just as we do with any other investment (see annex 1 for further details).

Figure 2. Age-Earnings Profile with and without Schooling



These returns turn out to be high indeed (table 2). They usually range from 10 to 30 percent. To be more precise: the economic literature on education estimates that one extra year of primary education will increase someone's future productivity (as, for instance, reflected in an hourly wage rate) by 10 to 30 percent.

Table 2. Economic Returns to Investment in Education (percent)

Argentina	10.0	Nigeria	30.0
Bolivia	9.8	Pakistan	20.0
Brazil	9.7	Philippines	18.3
Cyprus	15.4	Spain	31.6
Ethiopia	35.0	Yemen	10.0
India	19.8	Zimbabwe	16.6

Source: Psacharopoulos 1994.

These high economic returns are the main reason why the development community is pushing for "Education for All": education is the surest way out of poverty because it has a very high economic rate of return.

But, remember, we were talking about a girl who is healthy, well nourished, and well developed for her age—ready to learn. When you put a child like this in a good school, the benefits are high.

Unfortunately, the situation in many parts of the developing world is much more grim. Despite tremendous progress during the past three decades, the struggle for survival of young children in low-income countries, as well as in poor areas of middle-income countries, is not over yet. In 25 out of 40 low-income countries, the infant mortality rate still exceeds 100. The children who do survive often suffer from malnutrition (whether from lack of protein or from lack of one or more of the essential micronutrients). Furthermore, despite major progress in all parts of the world, primary enrollment rates in some countries are less than 60 percent and lower yet for girls. Once in school, it is not uncommon for children to repeat grades or drop out before graduation,³ resulting in many children being functionally illiterate. Table 3 gives an example of the social indicators for children as often found in poor countries or in poor regions of middle-income countries.

Table 3. Hypothetical Social Indicators in Poor Countries

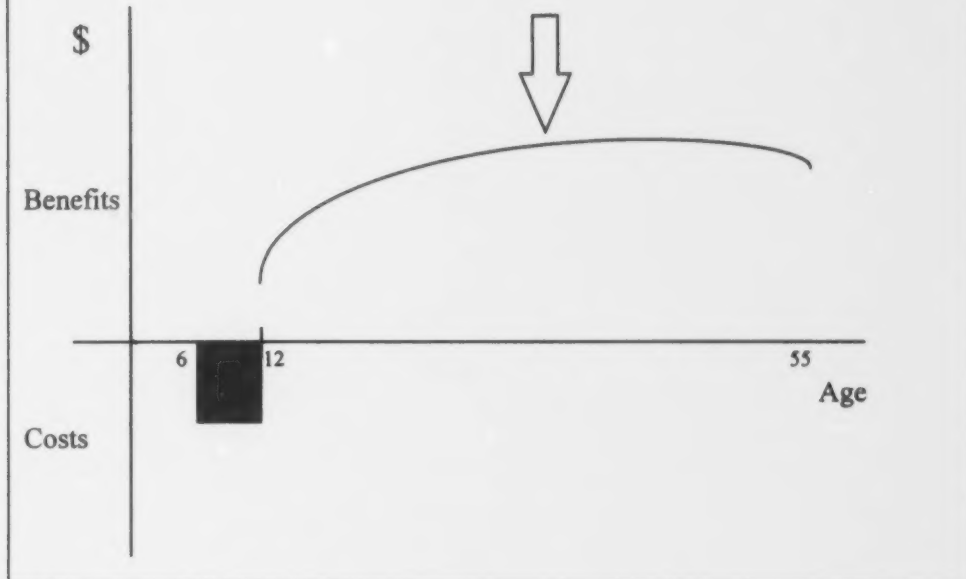
Indicator	Value
Infant Mortality Rate	150 per 1,000
Child Mortality Rate	50 per 1,000
Malnutrition	50 percent
Primary Enrollment	60 percent
Average Late Enrollment	2 years
Drop-out Rate	30 percent
Repetition Rate	30 percent

From this example it is clear that most children in poor countries will never reach their full productive potential. Some will die before they reach school-age, others will be damaged in early life due to malnutrition, disease, and lack of a stimulating learning environment. Not all will enter school, and those who do may drop out. Figure 3 illustrates the loss in productivity associated with the kind of social indicators that are characteristic for a poor society. The "age-earnings profile" shown can be interpreted as being for an entire cohort of, say, 1,000 newborns. We view ECD programs as a

³Repetition and dropout are major problems in the developing world and are often linked to poverty (see, for example, Patrinos and Psacharopoulos 1996).

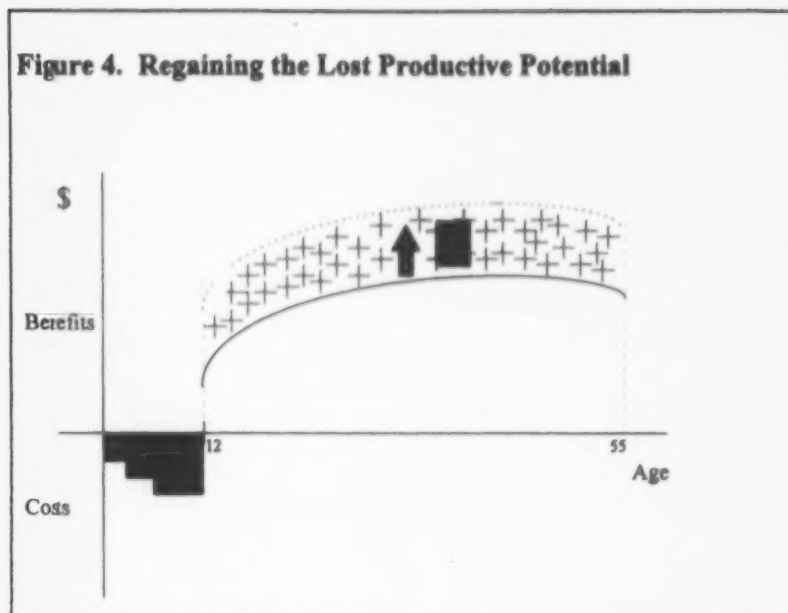
comprehensive approach to address the set of problems that prevent the children in this cohort from reaching their full productive potential.

Figure 3. Reduction in the Cohort's Full Productive Potential



By investing in these children *in their first years of life* we improve their chances to develop fully into productive adults. By comparing the gain in productivity (area B in figure 4) to the cost of the investment (area C, which now includes investments in ECD programs in addition to primary education) we can obtain the benefit-cost ratio of the ECD investment.

Figure 4. Regaining the Lost Productive Potential



We use this approach to estimate the benefits of ECD programs that materialize in terms of higher productivity,⁴ but, in order to do so, it is important to distinguish three groups in the population: wage earners, the self-employed (agricultural and nonagricultural), and those who do not work in the marketplace (the voluntary unemployed).

Wage earners.

Age-earnings profiles are usually estimated from data on wage earners only. Whatever systematic wage differentials one observes among workers with different levels of education is, *ceteris paribus*, considered to be a reflection of increased productivity as a result of education. This assumption will be closest to the truth in undistorted labor markets. Public sector wages, for instance, may reflect factors other than productivity (e.g., when the government hires large numbers of workers to keep unemployment down). In general, one can expect private sector wages in nonunionized markets to best reflect productivity differentials.

⁴This approach is not new. Selowsky (1981) states: "...by increasing the level of early cognitive development of poor children [the preschool intervention] could (a) increase the productivity of a given amount of schooling, and (b) generate additional benefits to the extent it induces additional schooling" (p. 332).

Self-employed.

It is sometimes argued that the real role of education is not to increase productivity but to "signal" to future employers the capacity and talent of the worker (Arrow 1973; Spence, 1973). By completing a certain level of education, the student receives a diploma which serves as a "ticket" to enter into the formal wage sector. Consequently, one should not interpret wage differentials as direct reflections of productivity differences, nor can one use results from the wage sector as proxies for productivity differences in the self-employment part of the economy.

These arguments have been refuted by two streams of research. First, studies that have used direct measures of cognitive skill (such as test scores) show that wage differentials do reflect differences in human capital, not just differences in "diplomas" (Knight and Sabot 1990; Murnare and Willett 1995). Second, there is a large literature on the effect of education on agricultural productivity showing that education significantly adds to output (see, for instance, Lockheed, Jamison, and Lau 1980; Tlak, 1993).

As a first approximation, therefore, one could use the results from the formal sector (the wage equations) as an estimate for productivity differentials for the self-employed. If data on the incomes of self-employed workers were available, one could estimate separate age-earnings functions for this segment of the economy. However, the benefits of increased productivity show up ten or more years after the ECD intervention (i.e., after the time of the analysis). To incorporate sector-specific effects of education on productivity, one needs to project the sectoral composition of the economy ten to thirty years ahead. Partly because of the lack of data, and partly because of the difficulty of projecting the development of an economy decades ahead, we expect most studies to accept the estimation results of the formal (wage) sector as valid for the entire economy.

The voluntary unemployed.

Anyone who has ever looked at time-use studies of persons (usually women) who stay at home would hesitate to call this population group "unemployed." Table 4 shows an example of the typical activity pattern of these women.

Table 4. Home Production: Average Hours Spent per Day By Mothers in Rural Households

Activity	Hours per Day	Activity	Hours per Day
Cooking	2.06	Feeding or Chopping	0.07
Breastfeeding	0.36	Household Chores	2.76
Bottlefeeding	0.01	Storytelling	0.003
Caring for Children	1.69	Care of Aged or Sick	0.04
Marketing and Travel	0.39	School or class	0.04
		TOTAL	7.42

Source: Adapted from King and Evenson 1983.

It is exactly this home productivity that manifests itself in the link between better education levels of the mother and a host of favorable outcomes such as healthier (and often fewer) children, better nutritional status of all household members, better hygiene, and more attention to learning. A major challenge is how to place a (monetary) value on improvements in home productivity that result from better education.

We make the following strong assumption to facilitate the benefit-cost analysis:

Productivity differentials in the marketplace that are due to differences in education levels can serve as a proxy for differentials in home productivity. For example, if five years of schooling increases future wages by 40 percent, the difference in home production between someone without education and someone with five years of education is estimated to be 40 percent.

This assumption⁵ allows us to estimate directly from the age-earnings profile the value of the benefits *that will accrue to the household* as a result of a higher education level of the mother. Alternatively, this value needs to be obtained from individual effects (e.g., better child health), the value of which could be equated to the costs of programs that yield similar effects (e.g., child health care).

In any case, it is extremely important to avoid double-counting: If one uses the wage equations to estimate differentials in home productivity, one should not also add the benefits in terms of improved children's health or improved nutritional status that result from higher education levels of mothers. Conversely, if one values the components of home production individually, one should first separate the population among those who will enter the labor market (ten or more years in the future) and those who will not. The benefits of increased labor-market productivity should subsequently only be added to the future wage earners and self-employed and not to the "unemployed" (i.e., those who produce at home). Of course, again, predicting which percentage of the population will work in which segments of the economy (including at home) one or more decades in the future is often beyond the ability of the analyst. The assumption that productivity differentials in the marketplace can be used as a proxy for productivity differentials at home circumvents this difficulty.

The involuntary unemployed.

We need to address one more important topic: how to deal with the involuntary unemployed? The answer is: we don't know. The previous discussion assumed implicitly that people have a choice regarding their employment. If their home productivity (their "reservation wage") exceeds the wage they can get in the marketplace, they stay home. If the market wage exceeds their reservation wage, they will work in the market for wages or as self-employed workers. For many developing countries, this is probably not a bad assumption. In the absence of adequate social safety nets (e.g., to

⁵ The assumption is based on the theory of "reservation wages" (see Mincer 1963; Gronan 1973 1986; Smith 1980).

insure against involuntary unemployment), people either have to produce at home or in the marketplace.

However, when unemployment is high among the well-educated, the value of their home production is likely to be well below their market value. An efficient labor market would reduce wages in the presence of large unemployment which, in turn, would reduce the economic benefits of education but would allow the framework stated above to stay intact. "Wage-stickiness," however, creates involuntary unemployment, which may imply that much of the potential value of education (especially higher education) will not be realized. In practice it will prove extremely difficult to predict involuntary unemployment levels ten to thirty years in the future. Nevertheless, the issue is important. At a minimum it points to the relevancy of stable market-oriented macroeconomic policies to realize the benefits of investments in human capital.⁶

3.2 Other Benefits from Education

The benefits of education are most visible in the marketplace, where they are reflected in higher wages. We have argued that these marketplace "productivity" benefits are a reasonable proxy for differentials in home productivity. Still, there are many other benefits associated with education that are not captured by these productivity gains. Some of these benefits accrue directly to the educated individual, but other benefits may have a wider impact.⁷ Table 5 shows a catalog of impacts of schooling, the nature of these impacts, and the state of our knowledge of the economic value of the impacts (Haveman and Wolfe 1984).

⁶ Kaufmann and Wang (1995), Isham and Kaufmann (1995), and Isham, Kaufmann, and Pritchett (1995) show that projects that are implemented in a stable macro environment have benefits that are higher than otherwise.

⁷ Mingat and Tan (1996) argue that all benefits from education (including externalities) are reflected in the impact of education on a country's economic growth performance.

Table 5. Catalog of Impacts of Schooling, Nature of Impacts, and Evidence of Magnitude and Value of Impacts

Channel of Impact on Schooling		Economic Nature of Impact	Status of Economic Benefit Estimates
1.	Individual market productivity	Private; marketed; human capital investment	Increments to marginal-value products, reported as rates of return; producers' surplus neglected
2.	Nonwage labor-market remuneration	Private; marketed and nonmarketed; human capital investment	Rough estimates of true returns to schooling 10 to 40 percent greater than rate-of-return estimates
3.	Leisure	Private; nonmarketed; consumption	No firm evidence of the extent of value
4.	Individual productivity in knowledge production	Private; nonmarketed; human capital investment	
5.	Nonmarket individual productivity (e.g., do-it-yourself)	Private; nonmarketed; human capital investment	
6.	Intrafamily productivity	Private; some external effects; both marketed and nonmarketed; human capital investment	No estimates of economic value
7.	Child quality through home activities	Private; some external effects; both nonmarketed and marketed; human capital investment	No significant evidence of economic value except intergenerational-earnings effects (Swift and Weisbrod 1996; Spiegelman 1994)
8.	Own health	Private; modest external effects; partially marketed; human capital investment and consumption	Little evidence of economic value, except indirect evidence via earnings, weeks worked, and life expectancy
9.	Spouse and family health	Private (within household); modest external effects; partially marketed; human capital investment and consumption	Little evidence of economic value, except indirect evidence via earnings, weeks worked, and life expectancy
10a.	Fertility (viz., attainment of desired family size)	Private (within household); nonmarketed; consumption	No estimates of economic value
10b.	Fertility (viz., changes tastes for children)	Private (within household); some external effects; nonmarketed; consumption	No estimates of economic value; perhaps impossible given nature of taste change
11.	"Entertainment"	Private; nonmarketed; consumption	No estimates of the value of increased efficiency
12.	Consumer choice efficiency	Private; some external effects; nonmarketed; human capital investment	No estimates of the value of increased efficiency
13.	Labor-market search efficiency (including migration)	Private; some external effects; nonmarketed; human capital investment	No estimates of the value of increased efficiency
14.	Marital choice efficiency	Private; minor external effects; nonmarketed; consumption	No estimates of economic value
15.	Crime reduction	Public good	No estimates of economic value
16.	Social cohesion	Public good	No estimates of economic value
17.	Technological change	Public good	No estimates of economic value
18.	Income distribution	Public good	No estimates of economic value
19.	Savings	Private; some external effects; marketed productive factor	No estimates of economic value
20.	Charitable giving	Both private and public; nonmarketed	No estimates of economic value

Source: Haveman and Wolfe 1984.

The first two entries correspond with the "productivity gains" in the marketplace we discussed in section 3.1.⁸ Items 3 to 10a could be captured under "home production," especially regarding the health outcomes of households with better-educated parents.⁹ These benefits accrue mostly to the household and are therefore a direct reflection of the gains in home production due to increased education. As we argued above, the value of this increased home productivity is captured in the reservation wage of adults who stay at home.¹⁰

The benefits listed from item 10a on, however, have thus far been ignored in our analysis. They accrue (mostly) to society as a whole and are therefore not reflected in the reservation wage. Unfortunately, as table 5 indicates, estimates of the economic value of these benefits are generally not available though some recent attempts have been made to quantify some components. Summers (1994), for example, equates the benefits of one birth averted (due to increased education levels of women) with alternative costs per birth averted (as a result of family planning programs). The number of averted births resulting from the education program is estimated based on a result in the population literature which shows that an extra year of education (of the mother) reduces fertility by 5 to 10 percent.¹¹ The economic benefits of the crime-reduction effect (item 15) have been estimated by Schweinhart, Barnes, and Weikart (1993). Chances are that this effect is highly country specific and that information about it will generally not be available. However, if such information exists, the reduced costs to victims as well as reduced costs for the judicial system and private security measures can be used as proxies for program benefits.¹²

Note finally that reduced dependency on social welfare programs (as included by Schweinhart, Barnes, and Weikart 1993) could be added to this catalog of education-related program benefits. However, in most poor countries such programs are not very well developed or do not exist and so ignoring these potential benefits in the analysis will have little economic impact on the end result.

We repeat that, in most cases where benefits accrue to society as a whole (benefits that have a public-goods character), information on the economic value is usually not

⁸Though we did not have separate information on fringe benefits.

⁹The article from which we borrowed this table is dated 1984. Since then, evidence for the effect of education on these outcomes has been greatly strengthened (see, for instance, Glewwe 1997).

¹⁰Throughout, we have ignored the value of leisure (item 3).

¹¹This is not a universal finding. See, for example, Jejeebhoy (1995) who provides a review of the literature and concludes, "For developing countries as a whole, data clearly indicates that the relationship between women's education and their fertility is reverse.... The danger is that aggregation may obscure considerable variation within countries.... Hence, examining aggregated relationships between education and fertility may mislead policy-makers, who would be better informed by reviewing individual-level studies" (p. 18).

¹²We do not have enough information to estimate these benefits for Bolivia.

available. As we see in section 6, this makes the decision of "who should pay" for the ECD program considerably more complicated.

3.3 Benefits That Are Not Education-related

While many of the benefits of ECD programs become evident through increased education levels of ECD graduates, many other benefits are more direct and are not related to the education system. The most obvious benefits of the program are the goods and services received by the child and her family. They include the value of food, health services, childcare and information and training for the parents. The benefits of these goods and services can usually be valued at market prices charged by alternative suppliers. In addition to these benefits, which are directly enjoyed by the participating families, there are other, indirect, benefits. Myers (1996) distinguishes five groups of beneficiaries: children, adults, communities, schools and health service facilities, and society (table 6). Most of the benefits that accrue to the children can be translated into increased future productivity and are thus captured in the analysis presented above. For most of the other benefits it will again prove to be very difficult to estimate a monetary value. One possible exception is the improved employment opportunity for mothers who enroll their children in an ECD program. If the childcare service inherent in an ECD program allows the mother to work in the marketplace (and thus, presumably, realize earnings that exceed the value of her productivity at home), the income gain (minus the possible loss in home productivity) can be counted as a benefit of the ECD program.¹³

¹³Though this may be the case for the PIDI program, lack of data prevent us from estimating the value of this benefit.

Table 6. Benefits of ECD Programs by Beneficiary Groups

Beneficiary Group	Area of Change	Indicators of Change
Children	Psychosocial development	Improved cognitive development (thinking, reasoning); improved social development (relationships to others); improved emotional development (self-image, security); improved language skills
	Health and nutrition	Increased survival chances; reduced morbidity; improved hygiene; improved weight and height for age; improved micronutrient balances
	Progress and performance in primary school	Higher chance of entering; less chance of repeating; higher learning and better performance
Adults (program staff, parents) and siblings	General health knowledge, general health attitudes and practices	Improved health and hygiene; improved nutrition (own status); preventive medical monitoring and attention; timely treatment; improved diet
	Self-esteem Relationships Employment	Improved relationships between husband and wife, between parents and older children; caregivers freed to seek or improve employment; new employment opportunities created by program; increased market for program-related goods
Communities	Physical environment Social participation Solidarity	Improved sanitation; more spaces for play; new facilities; greater female participation; greater demand for existing services, community projects benefiting all
	Efficiency	Better attention to health; changed user practices; reduced school repetition and dropout
Schools and health service facilities	Effectiveness Capacity Practice and Content	Greater coverage; improved ability, confidence, or organization; methods and curriculum content
	Health and education status Participation Productivity Delinquency Fertility Equality	Fewer days lost to sickness; a healthier population; a more literate, educated population; greater social participation; a more productive labor force; reduced delinquency; reduced fertility; reduced social inequality

Source: Myers 1996.

Finally, one should consider a benefit to society that could be of great importance, but the value of which may be impossible to estimate: the creation of a more just society, one in which all citizens have a reasonable chance to escape poverty. We discuss this benefit to society in section 5 and show that it is of crucial importance in the decision of who should pay for ECD programs. But first we use the framework presented above to try to estimate the benefits (and subsequently the costs) of a recently developed ECD Program in Bolivia.

4. An Example: The Bolivian PIDI Program

4.1 The PIDI Program

The Bolivian ECD Program (known as the PIDI program)¹⁴ consists of nonformal home-based day-care centers where children receive nutrition, health, and cognitive development services. Each center serves 15 children, ranging from six months to six years of age. There is one mother/caretaker who is assisted by one or two helpers depending on the number of children under age two in the PIDI.¹⁵

Children enrolled in the program receive two meals per day and a snack, which together provide 70 percent of their caloric requirements. PIDI staff make sure they are fully immunized. Children receive basic health care when needed, are regularly weighed and measured to monitor their physical growth, and engage in a relatively strict daily program of games and age-specific exercises to stimulate their cognitive development.

The target population consists of very poor households who live in periurban areas. Many are recent migrants from rural areas trying to improve their standard of living by finding employment in the city. Social conditions are characterized by high infant and child mortality, high levels of malnutrition, excess disease burden, and stunted psychosocial development. Primary school enrollment is very low. Repetition rates and drop-out rates are high. There is virtually no progression to higher levels of education. The program's objectives are (1) to improve children's readiness to succeed in school and beyond by facilitating their physical, emotional, social, and cognitive development; (2) to enhance the status of women by increasing their employment opportunities, and to expand their knowledge of health, education, and nutrition; and (3) to increase community and private sector participation in the social development process.¹⁶

The PIDI program is expensive. Recent estimates suggest that one-year enrollment in the project costs between \$300 and \$400. Given their socioeconomic conditions, between 150,000 and 300,000 children in Bolivia may be eligible for the program.¹⁷ Thus, depending on the scope of the program, recurrent costs could amount to between \$50 million, and \$100 million annually. To put this in perspective, the entire government budget for education in 1995 was about \$300 million.

Whether or not the PIDI program costs "too much" depends not on the level of expenditures, which is certainly considerable, but on the benefits that one expects from each dollar invested in this program. We already know how beneficial ECD programs can be in terms of improved health, nutrition, and cognitive development. We now attempt to estimate these benefits in monetary terms.

¹⁴Projecto Integral de Desarrollo Infantil.

¹⁵"The PIDI" refers to one home-based day-care center providing services to 15 children.

¹⁶See World Bank 1993.

¹⁷By the end of 1997, 20,000 are expected to be enrolled.

4.2 Direct Benefits from Service Delivery

ECD programs provide a number of services that directly benefit the enrolled child and her family. They include meals and health care and, as in the High/Scope Perry Pre-school example, childcare services. Additional direct benefits may include training for the mothers (for example, regarding a child's nutritional needs) which may be valued by these mothers for its' own sake.¹⁸

In general, it is not difficult to measure the value of the direct benefits. The value of the food benefit can be estimated as its market value. If health care services are provided, the cost of these services in, say, a clinic can provide an estimate of its value to the recipient. In the same way, all other services that are provided directly to the child or her mother or parents can be included in the analysis.¹⁹

If we restrict ourselves to the value of the two meals per day that PIDI children receive, the direct benefits would amount to \$150 (about half of the total service-delivery costs²⁰). Alternatively, we could use the total recurrent costs of the program²¹ as a proxy for the service-delivery benefits to the children and their families. This would put the direct service-delivery benefits at about \$300 per child per year.

Note that at this point it is irrelevant whether or not the parents pay for this food or any of the other services. We are only concerned with the benefit side, regardless of how the program is being financed.

4.3 Preparing the Base-Line Data for the Productivity Analysis

4.3.1 The Education System

This part of the analysis involves the benefits in the form of increased productivity resulting from more education. Therefore, we first need to characterize the Bolivian education system. In table 7 we show the four levels of formal education in Bolivia, from primary schooling to higher education. We also indicate the years required for each level and the unit costs of one year of schooling. For performance indicators we chose enrollment and drop-out and repetition rates by level of schooling. As the data show, Bolivia has a long way to go before the education of the population reaches levels sufficient to compete successfully in an increasingly knowledge-based and competitive global economy.

¹⁸Training may also yield additional benefits, for instance, spill-over effects to siblings of the enrolled child.

¹⁹Schweinhart, Barnes, and Weikart (1993) use the cost of childcare as an estimate for the "baby-sitting" services of the preschool program.

²⁰See Ruiz and Giussami 1997.

²¹Net of overhead costs such as administration and evaluation.

Table 7. Characteristics of the Bolivian Schooling System

School Level	Years	Cost per pupil per Year ^a	Enrollment Rate	Drop-out Rate	Repetition Rate	Enrollment in Target Group (percent)
Primary	5	228	0.95	0.35	0.10	20
Middle	3	228	0.70	0.30	0.10	0
Secondary	4	320	0.60	0.30	0.10	0
Higher	4	1598	0.20	0.10	0.10	0

^aIn Bolivianos.

The last column shows the education indicators for the target group: primary enrollment is just 20 percent.²² Progression to higher levels of education is virtually out of the question for these children. We finally note that child mortality is very high in Bolivia. The regional average for under-five mortality is estimated to be 109 for females and 127 for males. For the target group (the poorest one-third of the population), we estimate the rate to be as high as 200 per 1,000 live births.

Using data from a 1993 integrated household survey covering a representative sample of urban households, we estimated a wage equation that related differences in (the logarithm of) wages to differences in education levels and years of experience. Table 8 shows the results.

Table 8. Estimation Results of the Wage Equation

Primary School	0.42	College	1.76
Middle School	0.76	Experience	0.07
Secondary School	1.01	Experience Squared	-0.001

Note: The results are the authors' calculations: the constant term is 6.69. See annex I for details.

These results imply that someone who completed primary education earns 42 percent more (is 42 percent more productive) than someone without schooling. Since primary school has five grades, this amounts to a modest 8 percent increase in wages per

²² This is probably an overestimate; the real number may be closer to zero. Furthermore, for lack of data, we will assume for the target group, the same drop-out and repetition rates in primary school as for the population as a whole.

year of education (compare table 2). We also find that a college graduate earns on average 2.76 times as much as an unschooled wage earner. The estimation results on experience imply that wages peak after about 35 years of experience.

Armed with this information, we can now quantify the benefits of ECD programs that are manifested in increased productivity.

4.3.2 The Impact of the PIDI Project on Social Development

The first program effect we look at is increased survival. Once a child is born, she will grow up to become a productive member of society. The level of her productivity will depend on her physical and cognitive development during the early years of life, as well as on the investment in basic and higher education and on subsequent investments in human capital through continued learning and experience.

If the child dies prematurely, her future productivity, whatever its level, is lost for society.²³ Preliminary results from the PIDI program suggest that the mortality of those enrolled is extremely low, less than 1 percent. This contrasts with the high child mortality rate, about 20 percent, of the target population in the absence of the ECD intervention. Once children are enrolled in a safe environment where life-threatening diseases (e.g., diarrhea, severe malnutrition) are recognized and treated on time, children six months old or older have virtually a 100 percent chance to survive past the age of five.

Reliable information on changes in the nutritional status of enrolled children is not yet available. Possible changes in chronic malnutrition (stunting) may not be evident for years (they may not occur until the children reach puberty). Estimates of the program's effect on acute malnutrition (wasting) also await future evaluation efforts.²⁴

Of the children who initially enroll in the PIDI program, 40 percent show stunted psychosocial development. After one year in the program this percentage is reduced to 20 percent. After two years it is cut to five percent (Clemente 1996). If this result of tremendous progress in psychosocial development holds up under further scrutiny, it bodes well for the future chances of successfully educating PIDI graduates.

Before we can translate these results into monetary benefits, using the standard economics of education approach explained in the previous section, we need to translate

²³ This assumes that no child will grow up to be a "drag" on society. Very few citizens in the developing world take more from society than they contribute. Most grow up capable of taking care of themselves and their families, even if that means a subsistence level of well-being. Those with a productivity below subsistence will simply die in the absence of adequate safety nets. However, some citizens may get involved in activities that may have significant negative externalities for society. Illegal drug cultivation, violent crimes, and environmental degradation are examples. To the extent that ECD programs (directly or indirectly) can help reduce such activities in the future, one should count this as additional benefits of the program.

²⁴ Pinstrup-Andersen, Pelletier, and Alderman (1995) take stock of existing knowledge of the nutritional impact of a variety of project interventions. See also OED 1995 for an evaluation of the Tamil Nadu project in India.

these program effects on nutritional status and cognitive development into expected changes in enrollment, drop-out rates, repetition rates, and progression to higher levels of education. We are fortunate to have direct observations of changes in primary enrollment, but we have to turn to the literature (or to data on the general population) to obtain estimates for improvements in school performance.

Though the PIDI project is still young, the limited information available suggests that virtually all children who leave the program at age six enroll in primary school, up from 20 percent in the absence of the program. Part of this large increase is probably the direct result of improvements in the children's health and nutrition levels (see, for example, Glewwe and Jacoby 1993; Del Rosso and Marek 1995). Part, no doubt, also stems from parents' greater awareness of the benefits of education—a result of the parents' active participation in the program.

Given favorable outcomes on nutrition and school preparedness (or psychosocial development), one would expect improvements in school performance, which are reflected in reduced drop-out and repetition rates and increased progression to higher levels of education. Due to lack of more detailed information, we assume that PIDI graduates, once they are enrolled in primary school, will perform at the same level as the national average. Table 9 summarizes the relevant social indicators of the target group, with and without the PIDI program (scenario I).

**Table 9. Social Indicators of the Target Group,
with and without the PIDI Project**

	Scenario I		Scenario II	
	Without PIDI	With PIDI*	Without PIDI	With PIDI
Under-5 Mortality	200/1,000	10/1,000	162/1,000	105/1,000
Primary Enrollment	0.20	0.95	0.65	0.95
Middle School	0	0.50	0.50	0.70
Secondary	0	0.40	0.50	0.60
Higher	0	0.20	0.09	0.20

Note: We also assume that drop-out and repetition rates in primary school will be reduced by 50 percent.

This first scenario can be thought of as the result of a very narrow targeting effort that reaches the most deprived segments of society. We add to this an alternative (scenario II) which represents a part of society that already enjoys modestly favorable social indicators. The effects of the ECD intervention are therefore less dramatic than in the first scenario. We assume that the infant mortality rate and the primary enrollment rate can be improved to the national averages while progression to higher levels of

schooling improves modestly. Results from both scenarios will give us a range for the benefit-cost ratios.

4.3.3. The Dollar Value of Increased Productivity

We first estimate the net present value of the education system as it currently functions for the target group (20 percent primary enrollment, 35 percent dropout, 10 percent repetition, and no progression to higher levels of education). The 20 percent of children who do enroll have a higher level of productivity during their active lifetime than they would have had without this education. We use the age-earnings function to estimate this increase in productivity. We calculate the present value of this increase by discounting it at an annual rate of 7 percent. After subtracting the cost of education,²⁵ we obtain the net present value of the current education system.²⁶ Table 10 shows the results for a cohort of 1,000 children in the target population. For this cohort, the current education system increases lifetime productivity by \$264,517. These are society's "profits" from investing in the human capital of just 20 percent of 1,000 children in the target group—the net cost of education.²⁷ This relatively high number is, of course, a direct reflection of the economic returns to primary education that were estimated from the wage-earnings function.

Next we reduce the under-five mortality from 200 to 10 per 1,000. This adds 190 productive people to the cohort, of whom 20 percent will increase their basic productivity by enrolling in primary education. This raises the net present value of the education system from \$264,517 to \$327,340 (table 10, row A). In other words, we could invest $(\$327,340 - \$264,517) = \$62,823$ per 1,000 high-risk children just to increase their survival rates and still break even. Given the relatively cheap measures that are available to prevent the premature death of a child (e.g., a dose of oral rehydration therapy costs about \$2), survival appears to be a good economic deal on the sole basis of future productive contributions to society.²⁸

²⁵ Including opportunity costs for children over 10 years of age (see annex 2).

²⁶ All calculations are made using the "ECD Calculator." A detailed description of this program and its use is given in Annex II.

²⁷ The cost of this education amounts to \$171,456. Thus, the benefit-cost ratio is about 1.9.

²⁸ This exercise should not be confused with estimating "the value of life." See, for instance, Learning and Leadership Center 1996, chapter 9.

Table 10. Increase in Net Present Value (NPV) of Productivity due to Improved Social Indicators (Scenario I)

Description	NPV of the Education System ^a	Increase in NPV due to the PIDI Program
0. Baseline; without PIDI; net impact of education system	\$264,517	—
A. Under-five mortality reduced from 200 to 10 per 1,000	\$327,340	\$62,823
B. Primary enrollment increased from 20% to 95%	\$1,256,458	\$991,941
C. Improved survival and enrollment	\$1,554,867	\$1,290,350
D. As C, plus improved primary school performance ^b	\$2,061,574	\$1,797,057
E. As D, plus increased progression to post-primary	\$3,160,533	\$1,098,959

^aFor a cohort of 1,000 children in the target group.

^bDrop-out rate reduced from 0.35 to 0.15. Repetition rate reduced from 0.10 to 0.05.

Row B of the table shows the net benefits from increased enrollment (without increased survival). If the only effect of the ECD program would be to increase enrollment in primary education from 20 percent to 95 percent, the net present value of this benefit (measured only by the increased productivity of the cohort) would amount to \$1,256,458.

In the next rows we first combine the program's impact on survival and enrollment (row C). We then add a reduction in drop-out and repetition rates, from 0.35 to 0.15 and from 0.10 to 0.05, respectively (row D). Subsequently, we increase progression rates for the target group to postprimary levels of education, from zero to the national averages (row E).

Under these assumptions, the combined impact of the program on the lifetime productivity of 1,000 children in the target group has a net present value of \$3,160,533.

If one would be able to implement a program for preschool children that costs \$3,160 per child and that would produce changes in the under-five mortality rate and the education indicators in the target population, as given in table 6, the program would pay for itself in terms of higher lifetime productivity of the participants.

If a child enrolls for four years in such a program at \$350 per year, for a total cost of \$1,400,²⁹ the benefit-cost ratio of the program, on the basis of this benefit alone, would

²⁹This number is very high.

be 2.07. In other words, the net present value of the productivity-related benefits of the PIDI program exceeds the initial investment by 126 percent.

In Table 11 we show the results for Scenario II.

**Table 11. Increase in Net Present Value (NPV)
due to Improved Social Indicators (Scenario II)**

Description	NPV of the Education System	Increase in NPV due to the PIDI Program
0. Baseline; without PIDI; net impact of education system	\$966,212	—
A. Under-five mortality reduced from 162 to 105 per 1,000	\$1,031,933	\$65,721
B. Primary enrollment from 65% to 95%	\$1,412,156	\$445,944
C. Improved survival and enrollment	\$1,508,210	\$541,998
D. As C, plus improved primary school performance	\$1,997,847	\$1,031,635
E. As D, plus increased progression to postprimary education	\$2,901,864	\$1,935,652

As expected, the overall impact in this scenario is less than in the first (relatively extreme) case. Still, the overall benefits of \$1,935,652 imply a benefit cost ratio of 1.38 at a discount rate of 7 percent. Thus, solely on the basis of benefits that result from increased future productivity, the benefit-cost ratio of the PIDI program lies between 1.38 and 2.07.

4.4 Benefits Other Than Increased Productivity

Thus far, we have looked only at direct program benefits (such as food received) and benefits that emerge through increased education. Among the latter, we have looked at the effect of education on future productivity only. In this section we look at one additional benefit that results from improved education: reduced future fertility.

We assume that, because of the ECD program, girls will enjoy six years of education instead of not enrolling in school at all. As a result of this, fertility could drop by 30 to 60 percent.³⁰ Using the lower bound and a current fertility rate of 9 in the target group, the ECD program could reduce the expected number of births in a group of 1,000 ECD participants (500 girls) from 4,500 (fertility rate is 9) to 3,000 (fertility rate is 6).

The alternative costs of one birth averted is \$250. The economic benefits of the ECD program, as a result of reduced fertility, amounts to $1,500 \times \$250 = \$375,000$ for

³⁰Throughout this example, we use data from Summers 1994.

1,000 children enrolled in the program. Since these benefits are savings on population programs that would have to be implemented about ten years in the future, the discounted value of this benefit amounts to \$190,630, or \$190 per enrolled child.

It may seem contradictory to count both a death averted (reduced infant mortality rate) and a birth averted as program benefits, but it is not. Under certain conditions, a reduction in fertility bestows benefits on society that go beyond the benefits in terms of improved mother's health or improved quality of life for the (fewer) children in the family. At the same time, once a child is born, it is beneficial for society to help her grow up and become a productive citizen. Both the increased levels of productivity and the lower number of births are benefits that result from ECD programs.

4.5 The Costs of ECD Programs

4.5.1 Direct Costs

A recent study shows that the total costs of the PIDI program currently amounts to \$43.09 per child per month. Table 12 shows a breakdown of these costs by service-delivery category and administrative overhead. We estimate that the very high level of administrative costs will go down significantly once enrollment rates increase from about 15,000 children today to 30,000 or 100,000. For the time being we assume that, at high levels of enrollment, the annual costs per child will be between \$300 and \$400, about half of which would be for food.

Table 12. Cost Structure of the PIDI Program

Operating Costs	Percentages
Food	38.5
Operation	3.5
Health	0.4
Caretakers	15.7
Equipment	4.6
Maintenance	1.5
Support Staff	11.3
Training	1.4
<u>Total Operating Costs</u>	<u>77.0</u>
<u>Administrative Costs</u>	<u>23.0</u>
Total	100.0

Source: Adapted from Ruiz and Giussami 1997.

4.5.2 Fiscal Costs

In addition to the direct costs, we need to account for the costs associated with the financing of the program. If all costs would be recovered by charging user fees (private payments by the beneficiaries), the financing costs would be minimal.³¹ But, if all or part of the costs are covered by public (tax) revenues, the fiscal costs could be considerable.

Following Devarajan, Squire, and Suthiwat-Narueput (1997), we could obtain an estimate of the "marginal costs of public funds" from the economic literature. Based on a study for the United States, for instance, it is estimated that it costs society between seventeen and fifty-six cents to raise one dollar of extra tax revenue. Thus, if an ECD project is fully funded by the government, its marginal benefits should exceed \$1.17 to \$1.56 per dollar of costs (Devarajan, Squire, and Suthiwat-Narueput 1997, p. 42). Unfortunately, estimates of these fiscal costs are relatively scarce and vary widely by country and by type of tax. Diewert and Lawrence (1994), for instance, estimate that it costs eighteen cents to raise one dollar of labor taxes in New Zealand, whereas Ahmad and Stern (1987) estimate the marginal costs of an extra sales-tax dollar in India to be as high as eighty-five cents. Therefore, unless estimates of the fiscal costs of a specific tax are available for the country under study, this brand of economic literature provides little practical guidance.

There is another way of looking at the potential fiscal impact of a publicly funded ECD program (or, indeed, any other publicly funded program). The authors of a study of the Bolivian Emergency Social Fund (ESF) (Jorgensen, Grosh, and Schacter 1992) estimate that \$100 million of foreign investment would generate an increase in Gross Domestic Product (GDP) of about 2 percent. If we assume that a full-scale ECD program costs \$100 million and that the fiscal costs amounts to \$1.25 for every tax dollar raised, the ECD program would therefore "drain" \$25 million from the economy. Using the ESF multiplier result, we find that this could cause a 0.5 percent reduction in GDP. This, in turn, could result in a 1.0 percent increase in poverty.³²

In this case, the fiscal costs relative to the benefits, at least in terms of "increased poverty," appear to be modest. Still, the example shows the importance of checking the growth implications of even the most attractive of antipoverty programs. All evidence shows that economic growth is the best way to reduce long-term poverty.³³ Every social program that aims at reducing long-term poverty (the PIDI program is a prime example) should therefore be evaluated for its impact on economic growth. While reducing poverty through providing direct program benefits to the poor, one should be cautious that overall poverty may go up due to adverse effects on economic growth. For publicly funded programs, these adverse effects result from the fiscal costs of raising the revenues.

³¹They would be the sum of all costs involved in collecting the fees.

³²See Ravallion, Datt, and van de Walle 1991 who estimate that the income (GDP) elasticity of poverty is between -2.0 and -3.0. Based on the lower estimate, the number of urban poor (about 35 percent of the population, or 1.75 million) could increase by 17,500.

³³See, for instance, Ravallion 1995.

Finally, we should mention another, simpler, way of taking into account the fiscal impact of the program. For the PIDI program, \$100 million per year³⁴ constitutes about 6 percent of the Bolivian government budget. If increasing the fiscal burden is ruled out because of the possible adverse impact on economic growth, resources for the program need to be found within the current budget. This underscores that ECD programs need to compete for public money with other government programs, in most cases on the basis of benefit-cost ratio comparisons. The high benefit-cost ratio of ECD (see below) is likely to make it a tough competitor in the struggle for scarce resources.³⁵

4.6 Benefit-Cost Ratios for the PIDI Program

On the basis of the results presented above, we are now able to calculate benefit-cost ratios for the Bolivian PIDI program. We use the productivity gains as discussed for Scenarios I and II. We add the benefits (to the family) of direct services as well as the benefits (to society) of reduced future fertility. We are unable to quantify many of the numerous benefits listed in tables 5 and 6. We use \$350 as the total annual cost of enrollment in the ECD program and assume that children enroll for four years, for a total cost of \$1,400. The benefit-cost ratios are presented in table 13.

Table 13. Benefit-Cost Ratios for the Bolivian PIDI Program

	Benefit-Cost Ratio Scenario I	Benefit-Cost Ratio Scenario II
Benefits from Increased Productivity	2.07	1.38
Plus Direct Service Delivery (\$1,200)	2.93	2.24
Plus Reduced Fertility (\$190)	3.06	2.38

Thus, the benefit-cost ratio of the PIDI program lies between 2.38 and 3.06. To put these numbers in perspective, we present in table 14 the benefit-cost³⁶ ratios for different projects. Clearly, the value of the investment in the PIDI program compares favorably with that in the so-called "hard" sectors.

³⁴Note that this refers to an enrollment of 300,000 in the PIDI program. Current enrollment is just 5 percent of this.

³⁵This argument holds *ceteris paribus* for nonfiscal resources such as foreign borrowing or grants.

³⁶A better name would be benefit-investment ratios (see Gittinger 1982, 1984).

Table 14. Benefit-Cost Ratios for Selected non-ECD Projects

Project	Benefit-Cost Ratio
Hill Forest Development Project, Nepal ^a	1 18
Philippine Ilocos Irrigation Systems Improvement Project ^b	1 48
Large-Scale Alternative	1 32
Small-Scale Alternative	1 99
Livestock Development Project, Uruguay ^c	1 59
Livestock and Agricultural Development Project, Paraguay ^d	1 62
Cotton Processing and Marketing Project, Kenya ^e	1 80
Kunda Cement Factory, Estonia ^f	2 27

^aAsian Development Bank 1983 "Appraisal of the Hill Forest Development Project in the Kingdom of Nepal"

^bWorld Bank 1977 "Philippines Appraisal of the Irrigation Systems Improvement Project 1," 1488a

^cWorld Bank 1970 "Uruguay Third Livestock Development Project," PA-38a

^dWorld Bank 1979 "Paraguay Livestock and Agricultural Development Project," Staff Appraisal Report 2272-PA

^eWorld Bank 1979 "Kenya, Cotton Processing and Marketing Project," Staff Appraisal Report," 2272-PA

^fIFC "Cost Benefit Analysis of Private Sector Environmental Investments A Case Study of theKunda Cement Factory " IFC Discussion Paper Number 30

5. Who Should Pay?

What does a high benefit-cost ratio for ECD tell us about the role of the government in the financing of such programs? The unambiguous answer is, nothing.³⁷ As with all unambiguous answers, this one needs to be modified, but only slightly so. If the benefit-cost ratio is low, in particular if it is less than 1.0, no one in the private sector or in the government should invest in the project. In this sense, the benefit-cost ratio does have a value for public policy, but only after the decision has been made that government financing, in whole or in part, is justifiable. This latter issue — Should the government get involved? — depends on arguments other than the benefit-cost ratio. Two of these arguments are discussed here: (1) Who are the beneficiaries of the program? (2) What constitutes a “just” society?

5.1 Who Are the Beneficiaries of the Program?

As we showed in table 6, the beneficiaries include the child, her mother and other family members, the neighborhood, and society as a whole. In the example presented in section 4, a large share of the benefits that we were able to quantify in monetary terms accrues to the child and her family. Society as a whole is better off because of these benefits. If one defines social welfare as the summation over the entire population of individual welfare, social welfare goes up if one individual (or family) gains in welfare. This is the case here: the child and her family benefit and, therefore, society as a whole benefits. But the important observation is that the benefits accrue to the individual. They are *private benefits*.

Other benefits accrue not to the individual, but to her environment, be it the neighborhood (e.g., benefiting from increased participation) or the nation (e.g., benefiting from reduced aggregate fertility). Unfortunately, as we have seen above, it is usually very hard to quantify these *public benefits*. And it is exactly the magnitude of these public benefits, relative to the private ones, that is important in the decision of whether the government should finance or subsidize ECD programs and by how much. Strictly speaking, failure to quantify the public benefits leaves us empty-handed when it comes to the important decision regarding the proper role of the government in program financing.

All we can say is that there are benefits to society (“externalities”) from having a healthier, longer-living, better-nourished, literate, and higher-educated population. Hence, society (“the government”) should be willing to use some public resources to promote these outcomes. However, it is virtually impossible to put a dollar value on these benefits and, hence, on the amount of subsidies that are justified on the basis of these “externalities” arguments. Fortunately, there is another set of arguments that, while not decisive, can guide public policy. It regards the role of the government in providing a “level playing field” for all its citizens.

³⁷Devarajan, Squire, and Suthiwart-Narueput (1997, p. 37) state: “Traditional cost-benefit analysis addressed the following question: Will the project under consideration result in a net benefit to the economy? This is an important question. But the answer to this question says nothing about whether the project ought to be in the public or private sector.”

5.2 Toward a Just Society

There are solid economic reasons for society to want to reduce poverty. For example, if poverty breeds crime and violence, the nonpoor have a good reason to reduce poverty. Or, to take an example from the international development community, if poor countries start to grow, international trade will flourish and all countries—including the rich—will benefit. Indeed, many advocates of social welfare programs or international aid will use these “selfish” reasons to argue their cause.

Many countries, and the international development society as a whole, have taken the reduction of poverty as a major, and sometimes the overarching, social objective because of these “selfish” reasons or because of more altruistic motives. Either way, when societies place a large social value on reducing poverty (or on reducing inequality or promoting social justice), the social value of programs and policies that foster these outcomes should be considered as “benefits”

It will always be contentious to put a dollar value on these benefits, but it would be wrong to ignore them. Equality or reduced poverty has a social value. At a minimum, we could ask how much society (or politicians) are willing to pay for the positive impact on the distribution of welfare that is likely to result from alternative policies or programs.

ECD programs are a powerful tool for breaking the intergenerational cycle of poverty. As we have shown in section 4, under the right conditions, ECD programs also have significant economic benefits, especially for the (children of the) poor. But the poor, almost by definition, are unable to pay for the considerable costs of ECD programs. How can society justify providing (or subsidizing) ECD programs for those segments of society that are likely to benefit the most?

This is not the place to elaborate on what constitutes a “just society” (see, for example, Rawls 1971, Dasgupta 1993, 2, Sen 1985). However, a minimal notion of what constitutes “social justice” would exclude any state in which some groups of children are deprived of having a reasonable chance to live a productive life just because they are born in poverty. Even societies that are unable, or unwilling, to provide a “level playing field” across the board may want to put policies in place that allow all who have reasonable talents, and are willing to use them, a chance to enjoy a least-minimum level of well-being

Malnutrition during the early ages, excess disease, exposure to unsafe environments, and lack of stimulation damage children for the rest of their lives. The resulting lack of schooling (or inability to learn) traps them in poverty for the rest of their lives. ECD programs aim at preventing this damage and avoiding this trap. As such, if properly targeted, they deserve a place among the public policies that governments want to put in place to constitute a just society

6. Conclusion

Investments in the health and nutritional status of young children, and in their cognitive development, have multiple benefits. The benefits range from directly reducing the number of children who suffer from ill health, to enabling the children to enjoy more productive lives as adults, to improving society by, for example, reducing crime rates. In this paper we have tried to list all benefits of ECD programs in a systematic way and to quantify them in dollar terms where feasible.

In general, ECD programs are expensive. Moreover, ECD investments trigger further investments in human capital, thus increasing the total cost of the program.

We have compared the quantifiable benefits of one ECD program, PIDI, with its costs, and we obtained benefit-cost ratios between 2.38 and 3.10. This ratio is highest for interventions that target population groups whose social indicators show severe deprivation (e.g., high infant mortality rates, high malnutrition rates, low school enrollment, poor school performance).

The combined impact of integrated ECD programs results in a large increase in the accumulation of human capital. Because of this, ECD programs as an investment compare favorably in terms of economic rate of return alone with investments in the so-called "hard" sectors.

Whether *governments* should invest in ECD is a different question. The answer depends, in part, on one's assessment of the societal benefits (the externalities) of ECD and, in part, on one's definition of what constitutes a just society. The externality arguments in favor of public financing are very similar to those for education in general.³⁸

We have argued that a strong case in favor of public financing (or subsidizing) of ECD programs can be made on the basis of a minimalistic sense of "societal justice." ECD programs are likely to be most beneficial for children who grow up in the poorest households—the same households that cannot afford to pay for ECD services. This suggests that well-targeted *public* programs can maximize society's benefits of ECD interventions while remaining affordable. Since a large part of the benefits of ECD are *private* benefits, it seems reasonable to expect better-off parents to contribute to the cost of this investment in the future of their children.

Societies cannot prosper if their children suffer. ECD programs are a sound investment in the well-being of children and in the future of societies. By breaking the intergenerational cycle of deprivation, ECD programs are a powerful tool for obtaining the ultimate objective of development—to give all people a chance to live productive and fulfilling lives.

³⁸See Lott 1987 for a critical survey of these arguments.

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Annex 1

Annex 1: A Note on Estimating the Returns to Education

That education is an investment is now a widely accepted concept among academics and policymakers alike. Viewing education as such naturally raises the question, "How big are the returns?" This note recapitulates the main methods for estimating rates of return to education. It relies on Psacharopoulos (1981 and 1995) and Chiswick (1997).

Estimation procedures

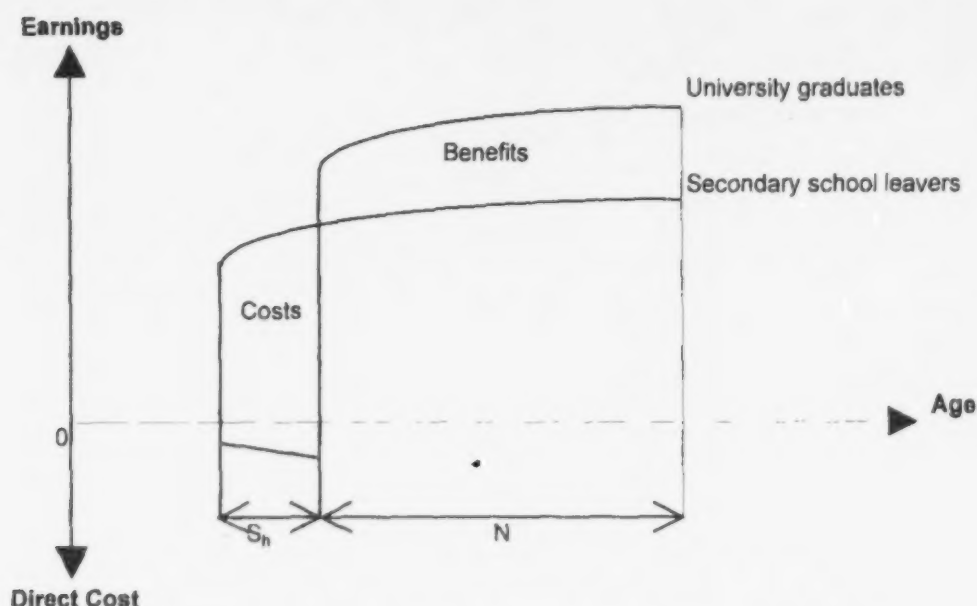
Three methods are commonly used. (a) the elaborate method, (b) the earnings function method, and (c) the shortcut method. The choice of technique depends on the type of data available for analysis as well as the assumptions used in the calculations.

(a) The elaborate method

This method follows from the generic definition of the rate of return to an investment, which is the discount rate that equalizes the sum of the discounted stream of costs of the investment to the sum of the discounted stream of benefits that it generates. In education, an investment in, say, higher education involves direct costs (which could be incurred by the individual student, or by the government in the form of subsidies to the student) as well as foregone earnings while the student is in school. The benefits from the investment materialize in the form of increased earnings relative to those obtained with less schooling. Typically, the reference group with less schooling is that in the next lower level of education (i.e., secondary education in this example).

The computation is easy to visualize in a graph showing the costs and benefits involved. Continuing with the example of higher education, figure 1 shows that direct costs in year t , $C_{h,t}$, are incurred over the duration of higher education, S_h . An additional cost is the earnings that a student foregoes while in school, these earnings are what a person with secondary schooling would have earned, and they amount to $E_{s,t}$ annually, again, over the duration of higher education. On the benefit side, the annual gain in year t amounts to the difference in the earnings of graduates with higher education ($E_{h,t}$) and those with secondary education ($E_{s,t}$). The value of t ranges from S_h+1 , the year following graduation from higher education, to N , the end of the working lifetime.

Figure 1. Earnings Profiles For Computing the Returns to Education



The rate of return to investments in higher education, r_h , would then be obtained by solving for it as in equation 1, which equalizes the benefit and cost streams discounted to year 1 at a discount rate of r_h

$$\sum_{t=S_h+1}^{S_h+N} \frac{(E_{h,t} - E_{s,t})}{(1 + r_h)^t} = \sum_{t=1}^{S_h} \frac{(E_{s,t} + C_{h,t})}{(1 + r_h)^t} \quad (1)$$

The calculation is easily accomplished using a standard computer spreadsheet program such as Excel or Lotus 1-2-3

Calculating the private and social rates of return To compute the *private* rate of return, the relevant costs are those borne by the individual student, and the relevant earnings refer to posttax earnings. For the *social* rate of return,³⁹ the direct costs include those borne by individual students as well as other entities, notably the government which often is a main source of subsidies for education. Where the government recoups some of its spending via tuition charges, the cost to the government should be net of such transfers. The benefit stream includes pretax earnings as well as any externalities. Because of the difficulty of estimating the latter, however, the calculation usually relies only on wage

³⁹Though it is customary in the literature to use the term "social rate of return," a better description would be "net private rate of return." The benefits are still private (higher wages), but the return is calculated using the full costs of schooling (including government subsidies)

data. Private sector wages, particularly in competitive economies, provide the most suitable data for this calculation, the assumption being that they are a good proxy for the marginal productivity of labor.

The same setup can be used to compute the rate of return to investments at the other levels of education. For primary education, however, the calculation is often adjusted to reflect the likelihood that children in the earlier grades of the cycle may be too young to work and, therefore, may not forego earnings or farm production while attending school. A common practice is to incorporate foregone earnings only for the last two or three years of the cycle

Data requirements. Like all the other methods, the elaborate method requires data on costs. On the benefit side, the requisite data relate to age-earnings profiles by single years of age and by education level. Such data can be tabulated from labor-market or other surveys, which are increasingly available in developing countries. Some of the cells may contain too few observations for reliable estimates of earnings, however. One way to minimize this problem is to proceed as follows. The first step is to use regression analysis to estimate age-earnings profiles for workers grouped separately by level of education (see equation 2)

$$E = a + b.AGE + C AGE^2 \quad (2)$$

In the second step, the estimated regression equation is used to simulate two earnings streams at single years of age over the working lifespan, one stream would be for workers at the level of education for which the rate of return is being calculated, the other is for workers with the next lower level of education. Once these earnings streams are derived, the data are inserted into equation 1 to compute the rate of return. The mechanics of this calculation has been automated by Psacharopoulos (1996)

(b) The earnings function method

This method also involves estimating a regression equation, but it is not to be confused with the data-smoothing procedure described above. The data needs are the same, however, as for implementing the elaborate method

$$\ln E = a + b SCH + c EX + d EX^2 \quad (3)$$

Specifying the regression equation The basic equation is as follows

where E refers to annual earnings, SCH refers to years of schooling, and EX refers to years of labor-market experience. The specification is generally attributed to Mincer (1974) who incorporated the experience variable into the basic schooling version developed by Becker and Chiswick (1966). Its rare feature is that it is not an ad hoc specification but is derived from the definition of a rate of return.

This equation is now a ubiquitous tool in the empirical literature on the economics of education. It is beyond the scope of this note to review the many extensions to the basic equation. Suffice it to note that these extensions commonly concern the role of other factors not included in the basic regression, including personal factors such as innate ability, gender, and race and institutional factors such as discrimination and unionization

For our present purposes we are mainly interested in how the earnings function is used to estimate rates of return to schooling. In the bulk of the literature, the regression coefficient on the schooling variable is interpreted as the *average private* rate of return to an extra year of schooling. This interpretation is valid under certain conditions. Chiswick (1997) shows that the relation between the coefficient estimate, b , and the rate of return to schooling, r , is more precisely specified as follows (equation 4).

$$r = \frac{b}{k} \quad (4)$$

where k is defined as the ratio between two items: the total cost for the "average" year of schooling, including direct costs and foregone earnings and the foregone earnings from a full year of work had the person been in the labor market instead of school.⁴⁰

Thus, when the regression coefficient is equated with the private rate of return, the interpretation ignores all the direct costs of schooling—whether borne by the government or by individual students—and assumes that, while attending school, a student receives no earnings from part-time work and therefore foregoes a whole year's worth of potential earnings. Under these assumptions, $k = 1$ since its numerator would be equal to the denominator.

In Chiswick's more general formulation, both private and social rates of return can be calculated by entering the relevant cost data in equation 4.⁴¹ The calculation can also be adjusted to allow for the possibility that students may work part-time while attending school.

⁴⁰ The relation is, in fact, precisely stated as

$$r = \frac{e^b - 1}{k}$$

The formula in the text relies on the use of an approximation in the derivation of the earnings function, namely that $\ln(1 + x) \approx x$ for small values of x . Rates of return to education typically do not exceed 35 percent, so the approximation is generally valid.

⁴¹ Following prevalent terminology in the literature, the term "social rate of return" to education refers to the result of a calculation that includes only the measured benefits from the investment, typically in the form of earnings. More correctly the social rate should include the value of externalities. In practice, this is not done because no easy way exists to quantify them in money terms. Note, however, that information is needed not on the absolute amount of externalities from a given schooling level, but on the difference in externalities across schooling levels.

To illustrate the mechanics of the calculation, consider the data and computations in table A1. The estimated coefficient on the schooling variable is 0.18, which would normally be interpreted as indicating an 18 percent private rate of return to an extra year of schooling above the sample mean. However, if we incorporate the data on costs and earnings from part-time work during the "average" year of schooling, the private rate of return would be 10.9 percent ($= 0.12/(200+250+(1,500-300)/1,500)$) and the "social" rate would be 7.7 percent ($= 0.12/(200+250+700+(1,500-300)/1,500)$).

Table A1. Illustrative Computation of Rates of Return to the Average Year of Schooling

Regression coefficient on the schooling variable, b	0.12
<u>Annual direct cost of schooling (\$)</u>	
Tuition cost paid by student	200
Other school-related, private direct costs	250
Public subsidy per student, net of tuition charges	700
<u>Earnings data (\$)</u>	
Earnings from part-time work while in school during the year	300
Full-year of foregone earnings	1,500
<u>Rate of return (% per year).</u>	
Private	10.9
Social	7.7

Estimating the returns by level of education The basic earnings function can be modified in several ways to facilitate estimation of the returns to schooling by level of education. One way is simply to add a new term, $e \text{ SCH}^2$, to the basic earnings regression equation 3, where SCH^2 is the square of years of schooling, and e is its regression coefficient. The

$$r_s = \frac{b + 2e \text{ SCH}}{k_{sch}} \quad (5)$$

rate of return to schooling investments over SCH years would then be given as noted in equation 5 where k_{sch} has the same definition as k above, but would be computed with data corresponding to the relevant block of SCH years of schooling instead of the "average" year. In this formulation, the rate of return for a given level of education would be derived by substituting into equation 5 the relevant value of SCH (e.g., $\text{SCH} = 5$ for primary education, $\text{SCH} = 12$ for secondary education, and $\text{SCH} = 16$ for higher education). The calculation makes the strong assumption that the rate of return is a smooth function of years of schooling.

An alternative method is to replace the schooling variable in equation 1 with three variables for schooling, YPRIM , YSEC , and YHIGH , defined, respectively, as years of primary, secondary, and higher education, thus, SCH is the sum of YPRIM , YSEC , and YHIGH . The regression equation would then be:

$$\ln E = a + b \text{ YPRIM} + c \text{ YSEC} + d \text{ YHIGH} + e \text{ EX} + f \text{ EX}^2 \quad (6)$$

For a person with fourteen years of schooling in an education system with six years in the primary cycle, four years in the secondary cycle, and four years in higher education, YPRIM would be coded as 6, YSEC as 4, and YHIGH as 4. For a person who dropped out of school after two years in the secondary cycle, YPRIM would be 6, YSEC would be 2, and YHIGH would be 0.

From this regression equation, the rates of return to schooling at the various levels would be as follows.

$$r_p = \frac{b}{k_p} \quad (7)$$

$$r_s = \frac{c}{k_s} \quad (8)$$

$$r_h = \frac{d}{k_h} \quad (9)$$

where k_p , k_s , and k_h refer to the ratio between the total cost of schooling (i.e., including out-of-pocket direct costs and foregone earnings net of remuneration from part-time work while at school) at the level indicated in the subscript (where p is primary, s is secondary, and h is higher) and the foregone earnings that the person would have received from full-time work had he or she not been attending that level of schooling.

Yet another procedure is to substitute education dummy variables for the continuous schooling variables used in the two specifications above equations 3 and 6. For example, we can define three dummy variables, PRIM, SEC, and HIGH, each of which take on the value of 1, if the observation has *at least* that level of schooling, and a value of 0 otherwise. The regression equation would then be as shown in equation 10.

$$\ln E = a + b \text{ PRIM} + c \text{ SEC} + d \text{ HIGH} + e \text{ EX} + f \text{ EX}^2 \quad (10)$$

In this procedure, the three dummy variables would be coded as follows: for a person with primary schooling PRIM = 1, SEC = 0, and HIGH = 0; for a person with higher education, PRIM = 1, SEC = 1, and HIGH = 1. Additional dummy variables could be

added to allow separate estimates of rates of return for complete and incomplete education at the various levels.

In the dummy variable specification, the rates of return to the various levels of schooling would be given as in equations 11-13

$$r_p = \frac{b}{S_p \quad k_p} \quad (11)$$

$$r_s = \frac{c}{S_s \quad k_s} \quad (12)$$

$$r_h = \frac{d}{S_h \quad k_h} \quad (13)$$

where S_p , S_s , and S_h refer to the years of schooling in the primary, secondary, and higher cycles, and k_p , k_s , and k_h are as defined above.⁴²

The foregoing expressions have their rationale in the basic earnings functions in equation 1. Consider, for example, the rate of return to secondary education, r_s . We assume that the rate is constant for investments spanning schooling from the end of the primary cycle to the end of the secondary cycle. Thus, when the years of schooling variable in equation (1) is S_p or $(S_s + S_p)$, the coefficient on the schooling variable would be equal to (r_s/k_s) . We therefore have the following expressions (equations 14-15).

$$\ln E_p = a + (r_s \quad k_s) S_p + c EX + d EX^2 \quad (14)$$

$$\ln E_s = a + (r_s \quad k_s) (S_s + S_p) + c EX + d EX^2 \quad (15)$$

⁴²An alternative way to code the education dummy variables is to set PRIM, SEC, and HIGH to 1 only for the *highest* level of education attained by the person. Thus, for a person with higher education, the dummies would be coded as PRIM = 0, SEC = 0 and HIGH = 1. The rate of return to the various levels of education would then be given by

$$r_p = \frac{b}{S_p \quad k_p} \quad r_s = \frac{c - b}{S_s \quad k_s} \quad r_h = \frac{d - c}{S_h \quad k_h}$$

By simple subtraction and rearrangement of the terms we obtain the following expression for r_s

$$r_s = \frac{\ln E_s - \ln E_p}{S_s \cdot k_s} \quad (16)$$

The numerator of the above equation corresponds to c in equation 10, thereby validating the formula in equation 12. The above calculation implicitly assumes that the age-earnings functions are flat or equidistant between adjacent levels of education.

To summarize, the earnings function approach to estimating the rates of return to education is highly versatile. It requires the same data as the elaborate method and may arguably be easier to implement given the availability of easy-to-use regression packages now available on the market. It has one major drawback, however, in that the method automatically assigns foregone earnings to primary school-age children. If children in the earlier grades are too young to work and therefore forego little, if any, economic production while attending school, the method is likely to underestimate the returns to primary schooling. In addition, the regression method cannot be used to simulate rates of return for alternative projections of the wage profiles of future graduates. Such simulations may be useful in assessing future investment options.

(c) The shortcut method

In this method, the rate of return by level of education is computed using equation 17:

$$r_i = \frac{AE_i - AE_j}{k_i \cdot S_i \cdot AE_j} \quad (17)$$

where r_i is the rate of return to investments in schooling level i , AE_i is average annual earnings of workers with the i^{th} level of schooling, and AE_j is the earnings for workers with the next lower level of schooling.

The equation is comparable to the method based on the earnings function in which schooling is included as a set of dummy variables for each level of education. Using secondary education as an example, we can rewrite equation 16 as follows:

$$r_s = \frac{\ln AE_s - \ln AE_p}{S_s \cdot k_s} \quad (18)$$

where AE_s and AE_p are the mean earnings of workers with, respectively, secondary and primary schooling. The equation can be manipulated by using the mathematical approximation $\ln(1+x) \approx x$ to obtain the following (equation 19)

$$r_s = \frac{\ln \frac{AE_s}{AE_p}}{k_s S_s} = \frac{\ln \left(1 + \frac{AE_s - AE_p}{AE_p} \right)}{k_s S_s} \quad (19)$$

The shortcut method requires much less data than the other two methods, since the formula assumes that earnings are independent of age. The latter assumption is an obvious drawback, and the estimates are sensitive to how the average earnings are computed. The method is nonetheless useful in situations where data are sparse and where the analyst requires only rough back-of-the-envelope calculations for exploratory purposes. The formula is also useful for making reverse cost-benefit calculations in which the analyst's task is to ascertain the magnitude of increased labor productivity (or increased wages) that would justify given levels of spending per student, on the assumption that the investment would yield a prespecified rate of return.

Annex II

Using the ECD Calculator

Ibrahima YANSANE

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ECD Calculator®

This program calculates the Net Present Value of a proposed or existing Early Childhood Development program. Worth is measured in the degree to which such a program increases a sample of 1,000 newborns' chances for survival, their enrollment, attendance, and performance in school, and their future earning potential.

The program measures the increase in productivity that can be expected from an ECD program over the cohort's lifetime, net of the additional schooling cost.

 **WARNING:** While the *ECD Calculator* makes it easy to assess the Net Present Value of an ECD program, results must be viewed with caution. *The Benefits of Early Child Development: An Economic Analysis*, which explains the assumptions on which these calculations are based, is essential reading for anyone interested in setting up, funding, or assessing an Early Child Development program.

SYSTEM REQUIREMENTS

- Excel version 5 or higher (no previous knowledge of Excel required)
- 8 MB of RAM, or higher
- 3 MB of disk space

 Please email comments, questions, and suggestions to ahusein@worldbank.org

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MAIN PAGE

ECD Calculator

Evaluating ECD Investments

This interactive computer program is designed to help educators calculate the net present value of Early Childhood Development (ECD) programs

You will be asked to provide information regarding your school system, child mortality rates, student attendance and performance, and the earning profiles of different age groups. The program will guide you to sources of data to look up information at each step

If this is your first time using the *ECD Calculator*, you may find it useful to practice with the examples provided before attempting to enter your own data

**To practice, choose a
sample country here**

Bolivia



**To insert your own
data, click here**

Enter Data

➡ **PROGRAM MENU AT TOP OF SCREEN**

Country Data

Page _____

Microsoft Excel - ECDcalc

[START HERE] [COUNTRY DATA] [INTERVENTION] [RESULTS] File Edit View Format Tools

Country:

Exchange Rate:

Child Mortality Rate:

School System:

	YEARS	UNIT COST (local)/YEAR	SCHOOL PERFORMANCE		
			ENROLLMENT RATE	DROP-OUT RATE	REPETITION RATE
Primary					
Middle					
Secondary					
College					

(Note: If any of these education levels is not applicable enter zeros)

Age-Earning Profile:

Constant (B0)	
Primary (B1)	
Middle (B2)	
Secondary (B3)	
College (B4)	
Experience (B5)	
Experience Sq. (B6)	

BASELINE SCENARIO

Based on a cohort size of 1000, the Net Present Value as reflected by data on the left hand side of this screen is

#VALUE!

This is the difference between earnings if all the children who survive DO NOT go to school and their earnings if we have this given school system

Now let's think about interventions

CLICK TO ENTER INFORMATION ABOUT INTERVENTION SCENARIO

[Back to the main page](#)

Left

Note: Please enter "0" where category does not apply

Right

BASELINE SCENARIO

Based on a cohort size of 1,000 newborns and the data entered on the left-hand side of this screen, the Net Present Value—that is, the profit or loss derived from a given investment—of this country's entire school system is

VALUE!

This number is the difference between the earnings of all children who survive if they DO NOT go to school and their earnings given the school system described

Now let's think about Early Child Development.

**CLICK HERE TO ENTER INFORMATION
ABOUT YOUR ECD SCENARIO**

BEST COPY AVAILABLE

QUESTIONS TO ASK WHEN ASSESSING ECD PROGRAMS

- 1 By how much do you expect your proposed or existing ECD program to lower the child mortality rate?

Enter
Values

Help

- 2 By how much do you expect your ECD program to affect school enrollment, dropout, and repetition rates?

Enter
Values

Help

- 3 By how much do you expect your ECD program to lower the cost of education and to raise the children's future earning potential?

Enter
Values

Help

Early Childhood Development Programs

Small Investments Early

save lives • improve performance • increase earning potential

Improvements in the following key areas have been shown to reduce the number of deaths among children under five, increase school attendance, improve performance, and raise children's earning potential. By targeting preschoolers, moreover, these improvements can be achieved at a relatively low cost. Early health and education interventions that proved to work include

- nutrition for pregnant women and nursing mothers (*micronutrient supplementation, nutritional and protein supplements*)
 - nutrition for children (*micronutrient supplementation, school food programs, nutritional and protein supplements*)
 - safe drinking water and hygienic conditions
 - health care in the early years (*treatment for roundworm, whipworm, hookworm*)
 - quality preschool education
 - increased level of mothers' education
-

Common Childhood Problems and Examples of ECD Interventions

(scroll down for more)

PROBLEM 1: IRON DEFICIENCY

- raises risk of mortality 400 percent
- reduces resistance to infection
- inhibits growth
- makes children listless, inattentive, uninterested in learning
- causes 5 percent learning loss
- decreases productivity 20 percent

ECD INTERVENTION 1: IRON SUPPLEMENTATION

IMPACT	STUDIES
1 Eliminated differences in school performance and IQ between iron-deficient and normal children.	INDIA Seshardi & Gopaldas 1989
2 Increased cognitive achievement 10%, which translates into a 13-22% increase in potential earning power	INDONESIA Soemantri, Pollitt, and Kim 1985 Soemantri 1989
3 Improved IQ test scores	MALAWI Del Rosso & Marek 1996

PROBLEM 2: IODINE DEFICIENCY

- corresponds to 0.2-0.3% of the rate for stillbirths and neonatal deaths
- children born to iodine-deficient mothers at high risk for retardation, deafness, and poor growth
- causes 10% reduction in IQ and lowers capacity for learning
- makes children likely to enter school late, have difficulty learning, and drop out early
- causes 5% loss in overall productivity

ECD INTERVENTION 2: IODINE SUPPLEMENTATION

IMPACT	STUDIES
1 Improved IQ, especially among girls	BOLIVIA Bautista and others 1982

PROBLEM 3: VITAMIN A DEFICIENCY

- associated with a 23% increase in child mortality
- associated with a 10% increase in child morbidity

ECD INTERVENTION 3: VITAMIN-A SUPPLEMENTATION

IMPACT	STUDIES
1 Increased children's iron stores	THAILAND Bloem and others 1989
2 Increased resistance to infection	

PROBLEM 4: PROTEIN AND OTHER MICRONUTRIENT DEFICIENCIES

associated with

- 20% of maternal mortality (anemia)
- 34% of underweight children (anemia)
- partial (25% disability) and total blindness (50% disability)
- diminished learning capacity (protein deficiency)
- 22% less probability of attending school for stunted children
- decreased earning power*

* An increase in the height-to-weight ratio of one standard deviation is associated with a 14-34% increase in wages

ECD INTERVENTION 4: NUTRITIONAL AND PROTEIN SUPPLEMENTS

IMPACT	STUDIES
1 Only 5% likelihood for stunted children to attend school, as compared with 27% for normally fed children	NEPAL Moock and Leslie 1986
2 Children on supplements earned higher achievement tests scores than did children on placebos	
3 Longitudinal study found that nutrition, both past (as measured by height for age) and current (as weight for age), were significantly associated with higher cognitive achievement and school performance	GUATEMALA Martorell and others 1995
4 Among children from poor homes, those who were stunted (low height for age) were twice as likely as their normal counterparts to repeat a grade	HONDURAS Israel (1988)
5 Malnourished children achieved 20% less than normal children	BRAZIL Harbison and Hanushek 1990
6 Malnourished children with poor eyesight achieved 27% less than normal children	
7 Adolescents who had received protein supplements when young scored 0.6 std higher on achievement tests than did matched children receiving a placebo	GUATEMALA Pollitt, Gorman, and others 1993

PROBLEM 5: MALNOURISHED CHILDREN

- enter school at later age
- complete fewer years of schooling (Glewwe and Jacoby 1993)

ECD INTERVENTION 5: SCHOOL-BASED FOOD PROGRAMS

INTERVENTION AND IMPACT	STUDIES
1. School breakfast program - increased attendance - improved scores on cognitive function tests - improved attendance - raised arithmetic scores, especially among wasted or stunted children	JAMAICA Simeon and Grantham-McGregor 1989 PERU Jacoby, Cueto, and Pollitt
2. School feeding programs - increased enrollment - promoted regular attendance - lowered repetition rates - lowered dropout rate in disadvantaged provinces - raised pass rates on national exams, especially for girls.	BURKINA FASO Moore 1994
3. School Canteens - raised test scores	BENIN Jarousse and Mingat 1991
4. School distribution of food stamps - increased enrollment 12% - reduced repetition and dropout rates	HONDURAS World Bank 1992

PROBLEM 6: ROUNDWORM, WHIPWORM, HOOKWORM

- diminishes learning capacity
- decreases ability to concentrate
- leads to malnutrition, diarrhea, anorexia, general malaise

ECD INTERVENTION 6: HEALTH CARE SERVICES

IMPACT	STUDIES
1 Cured children got better scores on cognitive function tests than did infected controls	JAMAICA Nokes and others 1992 WEST INDIES Bundy and others 1990
2 Single treatment for whipworm, with no nutrition or educational improvements	

PROBLEM 7: POOR PRESCHOOL PREPARATION

- leads to poor performance in school
- increases dropout and repetition rates
- diminishes future earning potential

INTERVENTION 7: QUALITY CHILDCARE & PRESCHOOL PROGRAMS

IMPACT	STUDIES
1 Reduced special ed Placements by [13% (Perry), 26% (ETPS), 14% (Head Start)]	USA <i>Perry Preschool Study</i> , Berruela-Clement, Schweinart, Barnett, Epstein, and Weikart 1984
2 Reduced grade retentions by (5% (Perry), 16% (ETPS), 12% Head Start)	<i>Early Training Project Study (ETPS)</i> , Gray, Ramsey, and Klaus 1982
3 Reduced high school dropout rate by (18% (Perry), 21% (ETPS), 17% Head Start)	<i>Head Start Study Georgia, USA</i> Monroe, MacDonald 1981
4 Raised chance of employment at age 19 by 18% (Perry)	
5 Significantly increased rates of school completion, monthly earnings, and home ownership (Perry)	BRAZIL Feijo 1984, Pontieri and others 1981
6 Lowered age of school entry, particularly for girls (India)	CHILE Richards 1985
7 Increased enrollments and attendance in Grade 1 (Colombia, India)	COLOMBIA Nimmicht 1986
8 Dramatically lowered in attendance and dropout rates in Grades 2-4 (Brazil, Colombia, India, Philippines)	INDIA Chatmvedi 1987 Lai and Wati 1986
9 Lowered rate of repetition (Argentina, Brazil, Colombia), especially for girls (Brazil)	MOROCCO Wagner 1984
10 Raised achievement test scores (India, Morocco) in Grade 3 (Turkey)	PERU Myers 1985
11 Improved scholastic performance and behavior, by teacher rating (India, Morocco)	TURKEY Kagitcibasi 1987
12 Made no difference in grades or results of special tests (Chile, Peru)	LATIN AMERICA (Four Country Study) Filp 1983

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BASIC INDICATORS

On the Web

1. Data from *The State of the World's Children*, on UNICEF's home page, at <http://www.unicef.org/sowc96/cover.htm>, can be downloaded in spreadsheet form

Search the web to find information regarding the Household Data Survey for the country in question

- 2 Search for key words

Example A search for **Bolivia + basic indicators + children** might turn up <http://netspace.org/hungerweb/HW/BBB/Bolivia/indicators.html>

CHILD MORTALITY RATE

Statistics on the CMR (death rate of children under the age of five) can be found under *The State of the World's Children* on UNICEF's home page at <http://www.unicef.org>

AGE-EARNINGS PROFILE

The Age-Earning Profile defines the degree to which education raises earning potential over a cohort's working life. The Wage Equation is defined as

$$\ln(\text{Earnings}) = \beta_0 + \beta_1(\text{Primary}) + \beta_2(\text{Middle}) + \beta_3(\text{Secondary}) + \beta_4(\text{College}) + \beta_5(\text{Experience}) + \beta_6(\text{Experience Squared})$$

This equation is a semi-log, ordinary, least-squares regression equation using the natural logarithm of earnings as the dependent variable and the potential years of labor market experience and its square. The constant (β_0) is the earning power of a citizen without education. The independent variables (*Primary*, *Middle*, *Secondary*, and *College*) represent the years of education attained at each stage. The rate of return for different levels of education is indicated by the β -coefficients.

On the Web

Key word search **wage + equation + education + [country]**

Publications

Psacharopoulos, G. 1994 *Returns to Investment in Education: A Global Update*. World Bank, Washington, D.C.
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EXCHANGE RATE

Current exchange rates are available from local financial institutes. Rates for 164 currencies are also available on the web at <http://www.olsen.ch/cgi-bin/w3ex-form>

COUNTRY NAME

**By how much do you expect your ECD program
to lower the CMR (rate of death for children under five)?**

%

Type in estimated percentage of reduction and press **ENTER**. The figure you have entered will appear under RESULTS and—together with the rest of the data you provide—be used to assess the value of your program.

Now return to **QUESTIONS TO ASK.**

COUNTRY NAME

By how much do you expect your ECD program to affect school enrollment, dropout, and repetition rates?

The values given below reflect rates before the ECD program. To return to these values, click on **INTERVENTION** at top of screen and on **reset to initial country values**.

CHANGES IN BASIC EDUCATION INDICATORS WITH ECD PROGRAM

Enrollment			Dropout Repeats	
Education Level	Rate (percent)		Level	Rate (percent)
Primary			Primary	
Middle			Middle	
Secondary			Secondary	
University			University	

Type in estimated percentages of how ECD will affect the rates in question and press **ENTER**. These figures will appear under RESULTS and—together with the rest of the data you provide—be used to assess the value of your program.

Now, return to **QUESTIONS TO ASK**.

COUNTRY NAME

By how much do you expect your ECD program to lower the cost of education and to raise children's future earning potential?

The values given below reflect rates before the ECD program. To return to these values, click on **INTERVENTION** at top of screen and on **reset to initial country values**.

CHANGES IN BASIC EDUCATION INDICATORS TOGETHER WITH ECD PROGRAM

Level	No of Years	Unit Cost/Yr	
		<i>local currency</i>	
Primary			
Middle			
Secondary			
University			

AGE-EARNINGS PROFILE

Educ Level	Unit Cost / Yr. <i>(local currency)</i>
Constant (B0)	
Primary (B1)	
Middle (B2)	
Secondary (B3)	
University (B4)	
Experience (B5)	
Experience ² (B6)	

Type in estimated percentages of how ECD will affect the rates in question and press **ENTER**. These figures will appear under RESULTS and—together with the rest of the data you provide—be used to assess the value of your program.

Now, return to **QUESTIONS TO ASK**.

RESULTS

Page _____

Microsoft Excel - ECDcalc

[START HERE] [COUNTRY DATA] [INTERVENTION] [RESULTS] File Edit View Format Tools

NET PRESENT GAIN IN COHORT EARNINGS (PRODUCTIVITY)

click here for a hint

BEFORE INTERVENTION

CMR

School System

	YEARS	UNIT COST per YEAR	ENRL RATE	D/D RATE	REP RATE
Primary					
Middle					
Secondary					
College					

Age-Earning Profile

Constant (B3)	
Primary (B1)	
Middle (B2)	
Secondary (B5)	
College (B4)	
Experience (B5)	
Experience Sq (B6)	

AFTER INTERVENTION (red marks indicate changes)

CMR

School System

	YEARS	UNIT COST per YEAR	ENRL RATE	D/D RATE	REP RATE
Primary					
Middle					
Secondary					
College					

Age-Earning Profile

Constant (B3)	
Primary (B1)	
Middle (B2)	
Secondary (B5)	
College (B4)	
Experience (B5)	
Experience Sq (B6)	

□

In this page you see the impact of intervention(s). Here, the programs shows the net present GAIN in cohort earnings (productivity), corresponding to the outcome of the specific intervention chosen. This gain is net of the additional education costs that result from the intervention. It does, however, not include the cost of the intervention. In other words, the gain shows the maximum amount you could spend on the intervention and still break even (you can get a hint by pressing on HINT)

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EARLY CHILDHOOD
DEVELOPMENT

EDUCATION
THE WORLD BANK

HUMAN DEVELOPMENT NETWORK

THE WORLD BANK